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(71) Applicant(s)
Northern Telecom Limited

(Incorporated in Canada - Quebec)

World Trade Center of Montreal,
380 St Antoine Street West,8th Floor, Montreal,
Quebec H2Y 3Y4, Canada

(72) Inventor(s)
Simon Daniel Brueckheimer
Roy Harold Mauger

(74) Agent and/or Address for Service
J P W Ryan
Nortel limited, West Road, HARLOW, Essex,
CM20 2SH, United Kingdom

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EP 0618706 A2 EP 0614324 A2 WO 94/11975 A1
US 5206858 A

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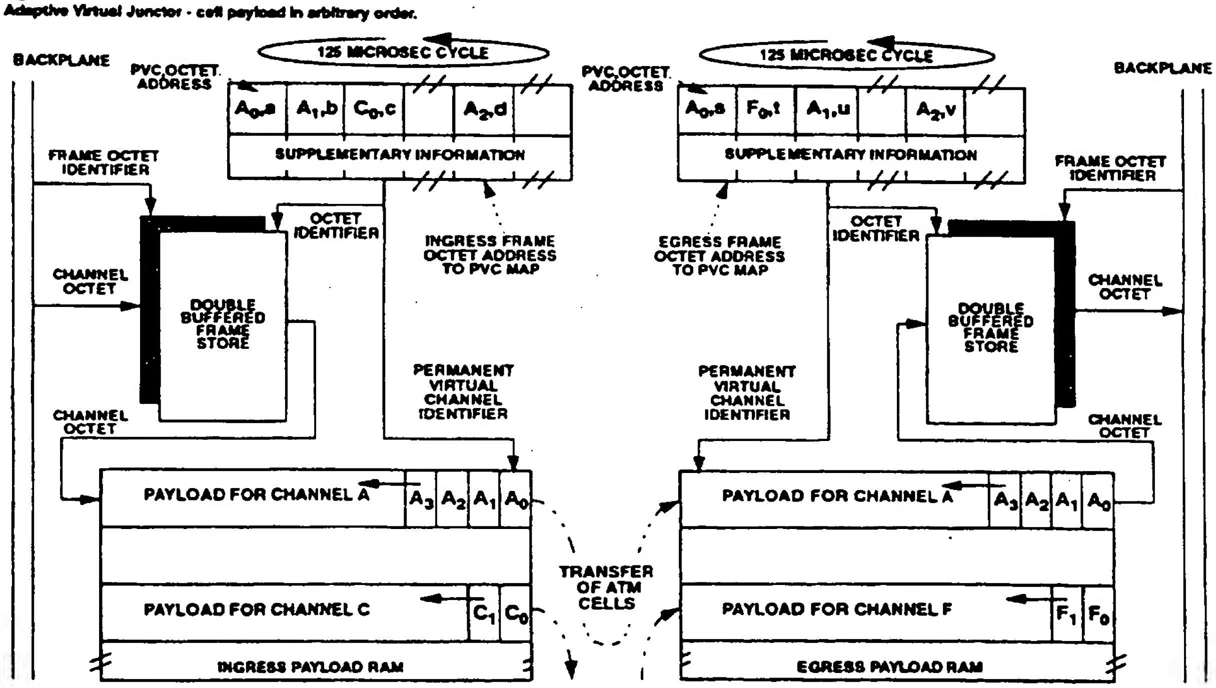
(54) **Communications system**

(57) Interworking between narrow band and broad band traffic in an ATM network is provided by a narrow band switch having a point to multipoint capability. Narrow band channels are mapped to time slots in broad band virtual circuits by providing a mapping between channel addresses and virtual circuit payloads.

Figure 3
Adaptive Virtual Junctor - cell payload in arbitrary order.



The references to figure 6 of the drawings in the printed specification are to b treated as omitted under Section 15(2) or (3) of the Patents Act 1977.

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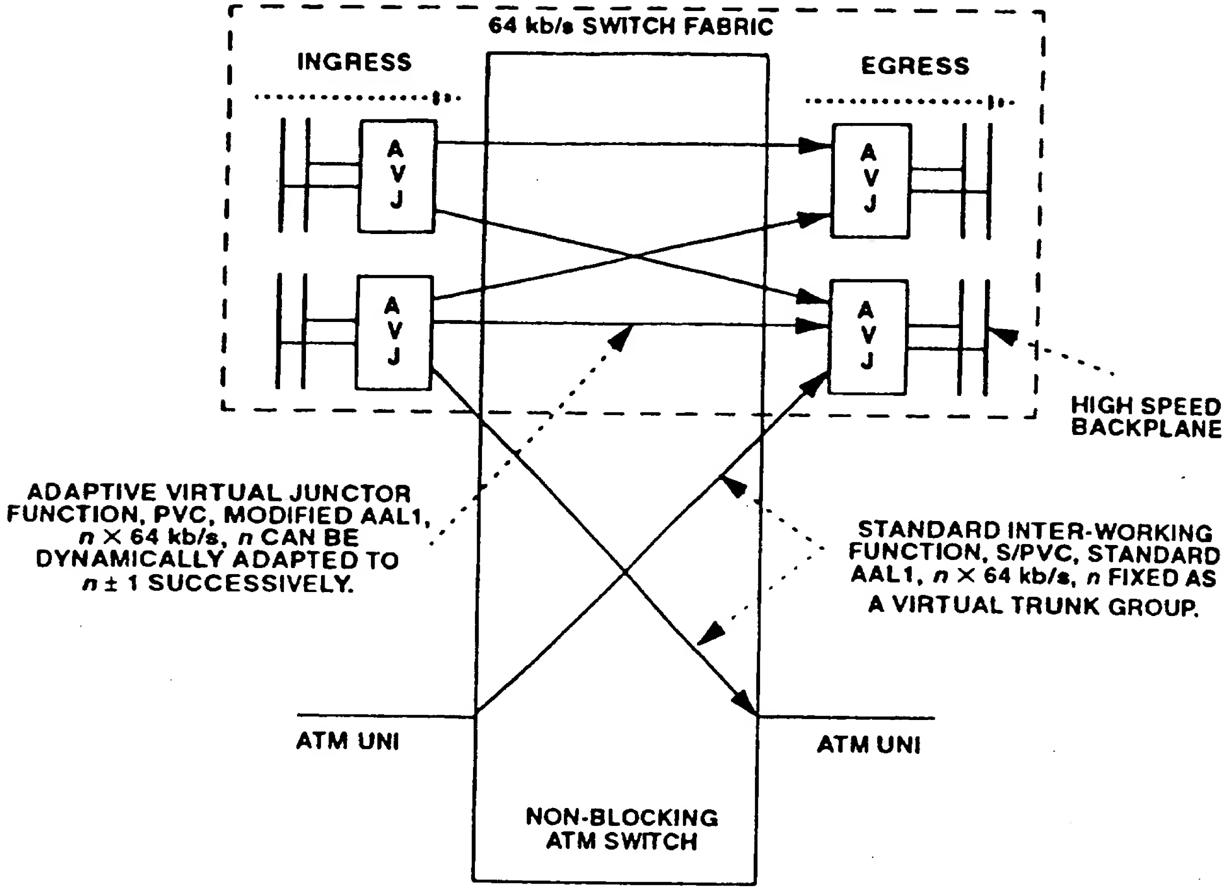
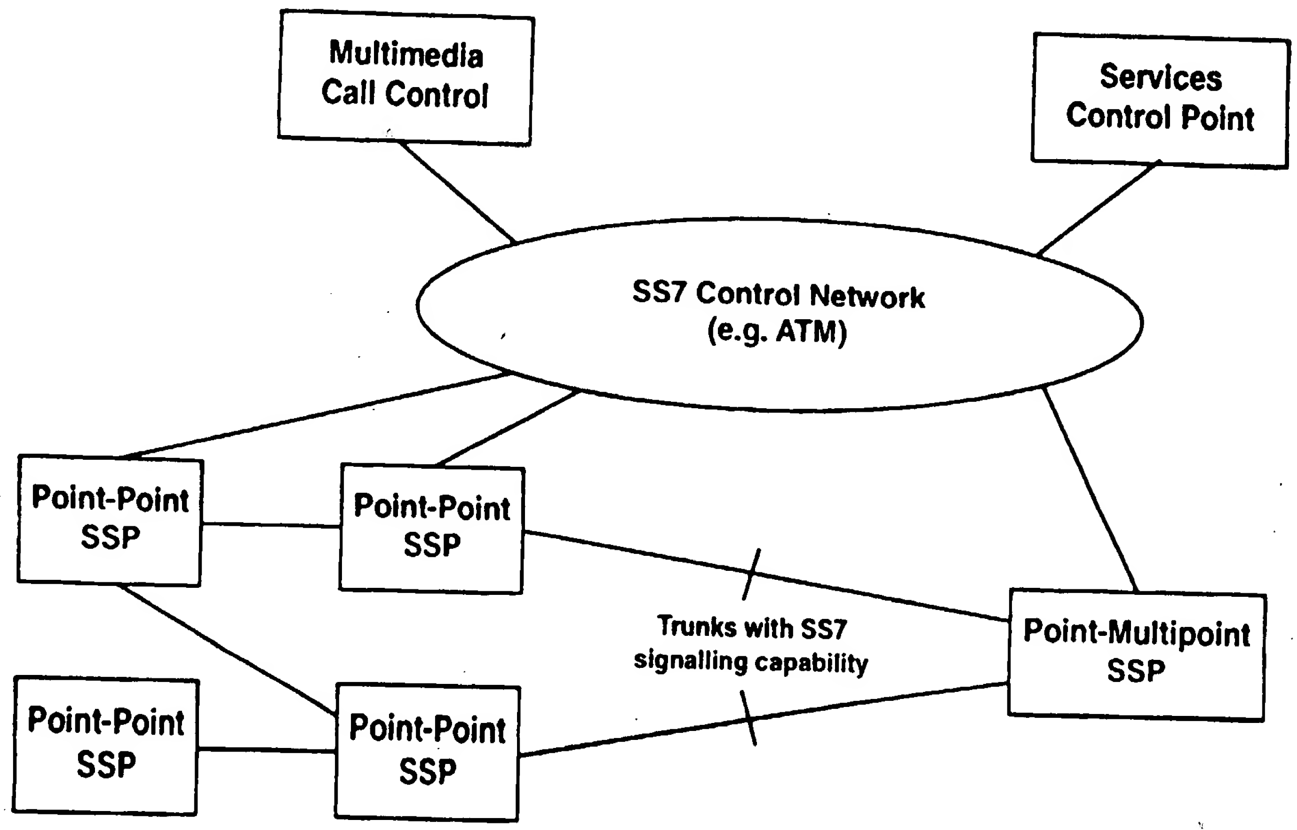

64 kb/s SWITCH FABRIC
INGRESS
EGRESS
A V J
A V J
A V J
A V J
HIGH SPEED BACKPLANE
ADAPTIVE VIRTUAL JUNCTOR FUNCTION, PVC, MODIFIED AAL1, $n \times 64$ kb/s, n CAN BE DYNAMICALLY ADAPTED TO $n \pm 1$ SUCCESSIVELY.
STANDARD INTER-WORKING FUNCTION, S/PVC, STANDARD AAL1, $n \times 64$ kb/s, n FIXED AS A VIRTUAL TRUNK GROUP.
ATM UNI
ATM UNI
NON-BLOCKING ATM SWITCH

Fig 1



SSP - Services Switching Point

Fig 2

Figure 3
Adaptive Virtual Junctor - cell payload in arbitrary order.

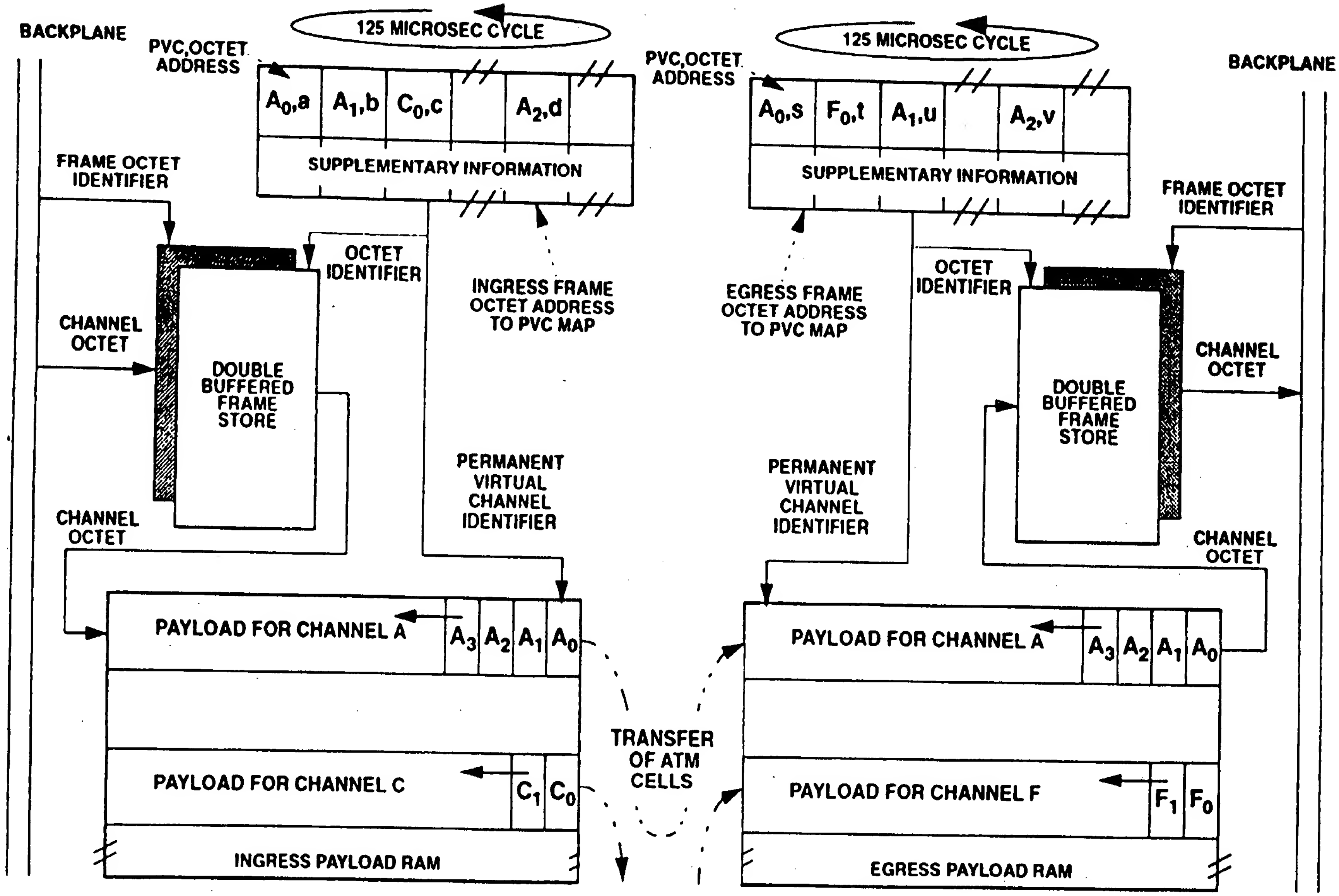


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Figure 5

Adaptive Virtual Junctor - cell payload ordered and employing multicast.

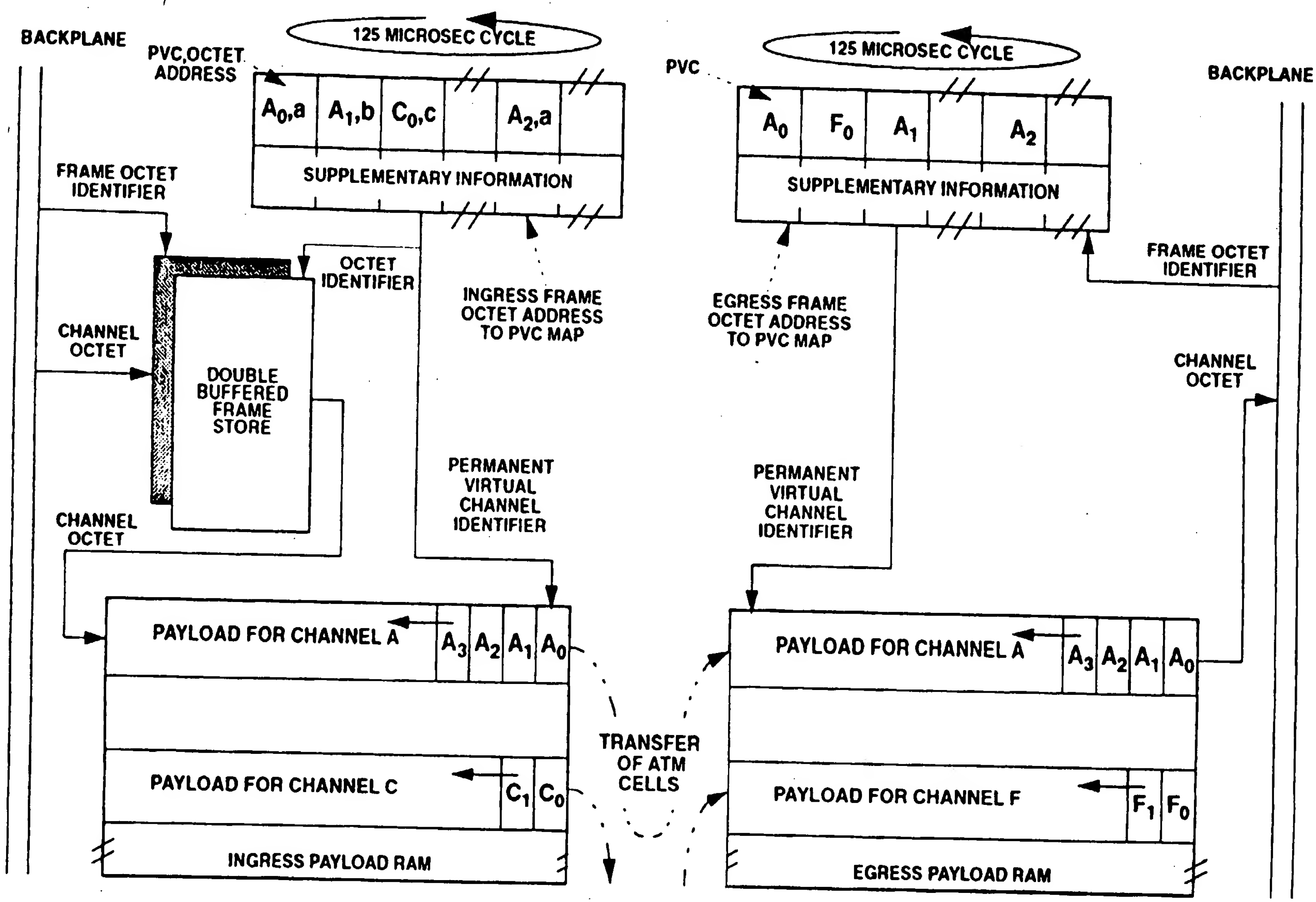
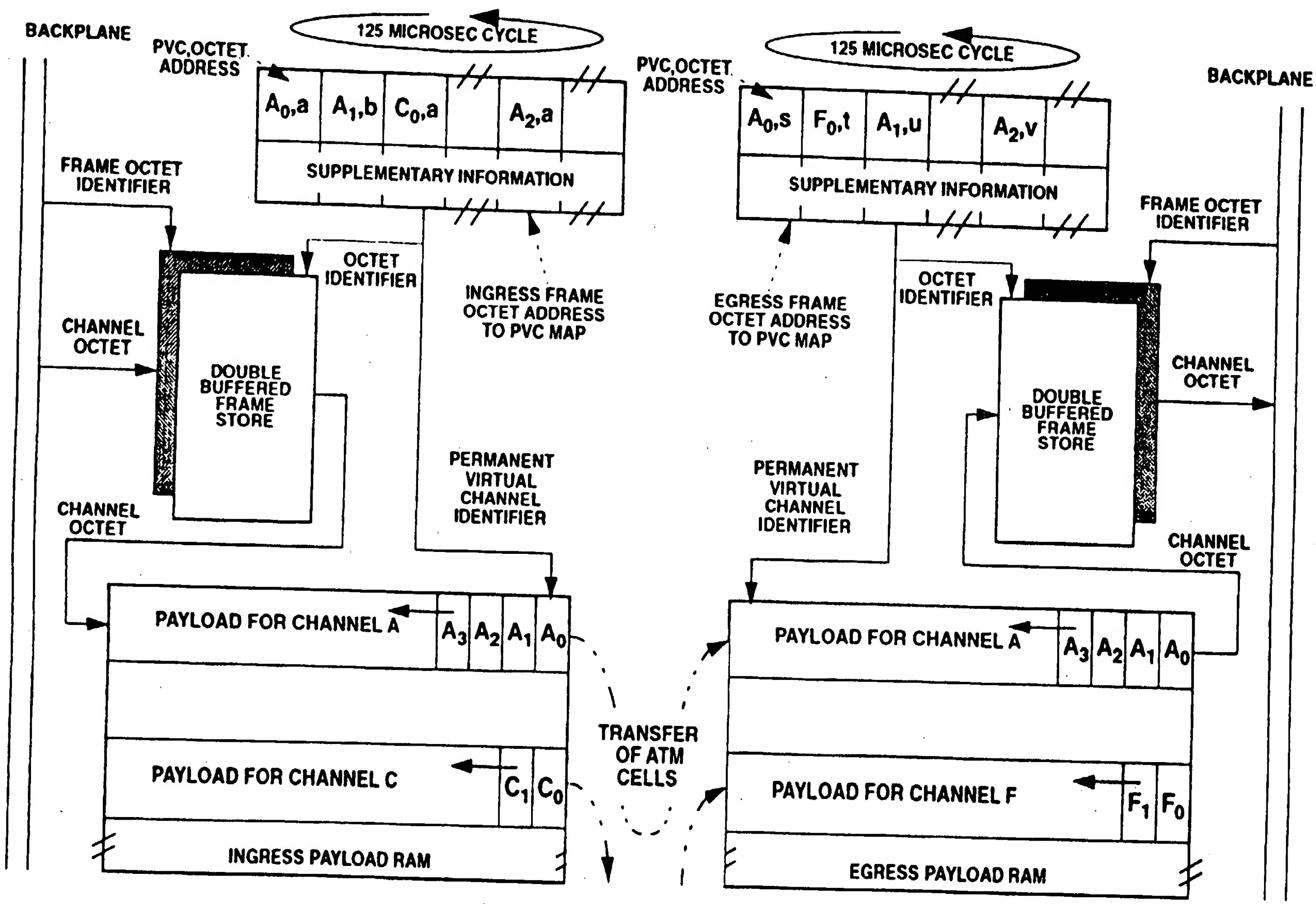


Figure 4
Adaptive Virtual Junctor - multicast of narrowband traffic.



Attention is here directed to our co-pending applications No. 9410294.4 (S D Brueckheimer - R H Mauger 7-6) and No. 9410295.1 (S D Brueckheimer - R H Mauger 8-7) and No. 9411894.0 (S D Brueckheimer - R H Mauger - A W Oliver - R J Dean 9-8-4-1) which relate to integrated broad band and narrow band access arrangements.

According to one aspect of the present invention there is provided a narrow band ATM switch for a communications network and adapted to work into a backplane bus associated with a backplane having ingress and egress facilities so as to separate switching from circuit adaptation, the switch having means for disassembly and reassembly of ATM narrow band channel payloads by providing a mapping between channel addresses and virtual circuit payloads.

According to another aspect of the invention there is provided a method of switching narrow band channels in an ATM communications network, the method including allocating said channels to time slots in a plurality of broad band virtual circuits by providing a mapping between channel addresses and virtual circuit payloads.

According to another aspect of the present invention there is provided an narrow band ATM switch for a communications network which provides point to multipoint capability on a narrow band channel basis in combination with bulk adaptation to ATM.

According to another aspect of the invention there is provided an arrangement for adapting an ATM switch whereby to perform a cell relay function into a narrow band switching fabric.

According to a further aspect of the invention there is provided an ATM switch having means for frame boundary rate adaptation.

The invention relates to inter-working between narrow band and broad band traffic in the public network. The most basic form of inter-working is for voice applications in which a POTS line or an ISDN B-Channel must be adapted to a Virtual Circuit using ATM Adaptation Layer 1 providing 64

COMMUNICATIONS SYSTEM

This invention relates to digital communications systems and in particular to systems embodying asynchronous transfer mode (ATM) technology. The invention further relates to an apparatus and method of switching narrow band traffic in such a system.

The asynchronous transfer mode (ATM) technology is a flexible form of transmission which allows any type of service traffic, voice, video or data, to be multiplexed together on to a common means of transmission. In order for this to be realised, the service traffic must first be adapted typically into 53 byte cells comprising 5 byte headers and 48 byte payloads such that the original traffic can be reconstituted at the far end of an ATM network. This form of adaptation is performed in the ATM adaptation layer (AAL). Five types of adaptation layer have been defined. This invention relates to adaptation layer 1 which is used to adapt constant bit rate traffic to the ATM standard.

ATM switches provide point-multipoint capability as a basic function. A combination of an ATM switch and a narrow band to broad band service interworking capability can therefore achieve point-multipoint in the narrow band network. This solution however has the problem that each narrow band to ATM adaptation incurs a 6 millisecond cell assembly delay which means that voice connections through the existing narrow band network will suffer from delay problems which require the use of additional equipment to effect for cancellation.

The object of the invention is to minimise or to overcome this disadvantage.

Figure 3 illustrates the ingress and egress process of an Adaptive Virtual Junctor means that can assemble and disassemble cell payloads in an arbitrary order of narrow band traffic;

Figure 4 illustrates an embodiment of the invention wherein the same means may be used to multicast narrow band traffic;

Figure 5 illustrates another embodiment of the Adaptive Virtual Junctor means, wherein the cell payloads contain ordered narrow band traffic with reduced path delay;

Figure 6 illustrates an embodiment of the invention for trunking applications wherein the junctor size may remain fixed but of arbitrary size forming a Virtual Trunk Group;

Referring to the drawings, a bulk implementation of an inter-working function is illustrated in Figure 1. A 64 kb/s switching fabric is typically implemented to work into a high capacity backplane bus; lines and trunks work into same bus so as to separate the concerns of switching from circuit adaptation. The inter-working device provides adaptation for e.g. 2048 channels of backplane bus capacity into as many virtual containers (VCs) as are required in order to fill a 155 Mb/s interface to an ATM switch. This requires a number of Virtual Circuits depending on the number of 64 kb/s channels in each virtual circuit. The device may be structured to allow any channel on the backplane to be allocated to any time slot within any of the virtual circuits.

The arrangement allows any channel on the backplane to be allocated to any time slot in a multiplicity of the virtual circuits to provide a multicast facility at a granularity of a single or multiple 64kb/s circuit. The particular application of this technique is for example to the provision of multimedia services via a broad band ATM network. Whereas the ATM network may provide multicast of cells, this is useful to the provision of narrow band services only when single channel adaptation is used, incurring the aforementioned disadvantages of delay, echo cancellation, and the need to provide Switched Virtual Circuits and signalling in the ATM domain.

kb/s connectivity between the two networks; this is required to work with voice services on an ATM workstation. The cell assembly delay for such a connection is 6 milliseconds which causes potential voice echo problems in many applications; echo cancellation to overcome such problems is well understood but is undesirable to implement. The more general inter-working case is for a P x 64 kb/s service typically used for H320 video conference where a value of P = 6 is typical; time slot sequence integrity is a special requirement of this application. The AAL1 can be used for unstructured data transfer in which a synchronous bit stream is passed transparently through an ATM network and reconstituted at the far end. For the flexible handling of 64 kb/s channels, the structured data transfer mode in which phase information identifying the start of an n x 64 kb/s sub-frame is preferred as it allows 64 kb/s channels to be identified and manipulated.

Multimedia networks can be provided using broad band technology based on ATM or on narrow band technology using 64 kb/s ISDN services and compression technology for voice and video. Switched multimedia is greatly enhanced by switches which provide a point-multipoint or multicast capability as this allows implicit conferencing. Multiple application of the point-multipoint function can be arranged to achieve a multipoint-multipoint service capability.

The invention further relates to a narrow band switch which provides point-multipoint capability in which the delay for each path conforms to the normal delay of 450 microseconds average (ITU-T Q551) thus allowing the switch to be deployed within the current network without delay problems.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:-

Figure 1 illustrates the use of an ATM switching element as the basis for a narrow band switching fabric;

Figure 2 illustrates the application of the present invention to multimedia services;

channel is available at an ingress AVJ and an egress AVJ it is also by definition available through the fabric.

When an ingress AVJ intends to change a VC from n x 64 kb/s to (n ±1) x 64 kb/s; it first signals ahead to the control element of the egress AVJ to identify the channel and the connection requirements to the backplane. The change is then implemented in the ingress function and the change is signalled within the junctor VC, preserving frequency and phase across the junctor VC. The act of changing the capacity of the network of junctor VCs on a call-by-call basis, is exactly equivalent to the operation of a 64 kb/s switching fabric from the perspective of attached lines and trunks. As the mechanism is the extension of the standard inter-working function, it is still possible to use part of the ATM switch for broad band purposes and to provide narrow band and broad band inter-working.

Whereas a group of AVJs dynamically adapt the capacity of the junctor VCs to adapt to the dynamic calling incidence of the 64 kb/s fabric, a Virtual Trunk Group (VTG) may provide a semipermanent pool of capacity between two switches which can be used as required to establish calls between the two switches. The respective roles are illustrated in Figure 1. The physical trunks between switches are implemented purely in the ATM domain. The capacity of these trunks is utilised to provide logical routes between destinations. A logical route comprises a number of VCs providing n x 64 kb/s, where for example, 6 < n < 30, and in addition an associated N-ISUP signalling channel. The lower value of 6 may be selected to avoid echo problems due to cell assembly delay; this means that a community of interest of at least six channels is desirable to justify a logical route. Changes to a logical route are achieved through Network Management action, and have a granularity of one 64 kb/s channel following initial establishment. Within each ATM switch, a network of AVJs maintains a 64 kb/s fabric function. The VTGs are connected through the synchronous backplane to the AVJ and have the ability to connect any backplane channel to any 64 kb/s time slot within any of the set of n x 64 kb/s VCs forming a logical route. In Figure 1, the VTGs are depicted as incorporated with the AVJs.

The ability to multicast in the narrow band domain enables advantages of bulk adaptation to be employed, namely the low delay, N-ISUP signalling, with the ability to locally switch or to trunk the traffic. The broad band network management need not be aware of the narrow band services used in this mode which separates the management aspects of the narrow band from the broad band network yet provides full interworking between the narrow band and the broad band network.

A typical application of the switch of Figure 1 is illustrated in Figure 2. It is assumed that an existing network has been upgraded to Intelligent Networking in which each switch in the network provides a Point-Point Services Switching Point (SSP), each SSP receives instructions from a Services Control Point at each significant trigger point in the call process. A new Point-Multipoint Services Switching Point according to this invention can be introduced into the network to provide switched multimedia services to the installed base of switches. In the example shown in Figure 2, the Point-Multipoint SSP is a form of switch which allows call control to be exercised from an external server, which is a multimedia call control Server in the example shown. Point-Multipoint calls initiated in the Point-Multipoint SSP can be extended on a Point-Point basis into the existing network using the trunks with SS7 capability which link the Point-Multipoint SSP with the existing network. This network architecture allows narrow band multimedia services to be delivered with all of the features planned for the broad band network.

The device used to adapt an ATM switch into a 64 kb/s fabric is termed an Adaptive Virtual Junctor (AVJ). An AVJ is attached to each port of the ATM switch which is to be used as part of the 64 kb/s fabric, illustrated in Figure 1. Each AVJ has a junctor Virtual Circuit with each other AVJ; each junctor VC is an n x 64 kb/s connection in which n is allowed to vary e.g. between 6 and 2048. Preferably 6 is set as a minimum so that the cell assembly delay of the fabric is never more than one millisecond avoiding all echo problems, although we do not exclude the ability to convey 64kb/s via ATM where n is less than 6. A control element is associated with each AVJ and all control elements use the ATM fabric to communicate control signals. The ATM switch is non-blocking, so that if a

channels, to a multiplicity of narrow band destinations via the same ATM adaptation means. The multicast facility is enabled by repeating in the PVC map an octet address in the frame store of the channel to be multicast, and using it as frequently in the map as the number of narrow band destinations, which destinations may be served by the same or a different ATM PVC or junctor, which may employ all the aforementioned and referenced means for creating a single switch fabric employing the same narrow band signalling means and the same rate adaptation means, which may multicast narrow band channels not exceeding the bandwidth of the switch port to which an adaptive virtual junctor may be connected.

Figure 5 shows another embodiment of the present invention which requires only one means of time slot resequencing, which resequencing is fully provided by the double buffered frame store of the ingress process, which may therefore order the time slots in the payloads of the cells of the junctor PVCs in their time slot sequence order of the respective egress backplane, thus providing the same aforementioned multicast facility. In this arrangement the egress double buffered frame store is no longer required. The advantage of this embodiment is a reduction in the path delay across the 64kb/s switching fabric. This will allow the single fabric switch to comply for example with ITU Standard Q551.

The process of the Virtual Trunk Group Device (VTG) is illustrated in Figure 6. This is similar to the AVJ, other than the channel's octets are free to be permuted in order both on assembly and disassembly of the payloads of the corresponding VC. The VTG is only accessed across the switch fabric by other AVJs, such that it need never accept local traffic directly from the backplane, nor deliver it directly to the backplane. Local traffic is adapted by an AVJ and then consolidated at a port on the switching fabric with traffic from other AVJs before being assembled into a VTG. A reciprocal process is implemented on receipt. The VTG requires the ability to resequence time slots at both ends of the trunk such that the VTG channels may be "nailed-up" in the connection tables or PVC maps. Since the VTG application always requires back to back working of the two backplanes, the ingress and egress resequencing may be provided

The principle of the adaptive virtual junctor is illustrated schematically in Figure 3. The diagram shows the process of assembly and disassembly of ATM payloads, the process cycling every 125 microseconds, although those skilled in the art will appreciate that any frame duration may be supported. Both the ingress and egress processes use an octet address to PVC map. This map relates a 64kb/s channel octet to the payload of a virtual circuit. The ingress side uses a frame store whose order of loading and unloading may therefore differ. The address of the octet in the frame from the backplane is used to access the map to provide a simple means to access all valid locations in the map once per 125 microsecond cycle, which map identifies a virtual circuit, an octet address in the frame, together with any supplementary information that may be need for cell assembly. The ingress map contains an address in the frame store such that the order in which the channel octets are concatenated into the payloads of virtual circuits may be freely chosen to match their time sequence ordering on the backplane of the egress process or any other desired order.

When completed, payloads are built into ATM cells using AAL1 structured data transfer as described in the aforementioned patent applications, and are despatched into the network. On receipt, the payloads are buffered to provide an elastic buffer to compensate for jitter and cell delay variation and for the payload disassembly process, under action of a similar map to the ingress process. The egress process accepts an octet address in the frame directly from the backplane and applies it to the PVC map, which stores an associated PVC identifier, octet address and any supplementary information as aforementioned for the ingress process. Octets are removed form the payload of cells for any given PVC, and transferred to a location in a frame store. At the end of the cycle the frame store is offered to the backplane and emptied in the time slot sequence order of the frame.

The contents of this map are primed and updated by an overall control process which has not been shown to ease clarity.

Figure 4 shows an example embodiment of the present invention wherein the adaptive virtual junctor applied to multicast narrow band n x 64kb/s

CLAIMS:-

1. A narrow band ATM switch for a communications network and adapted to work into a backplane bus associated with a backplane having ingress and egress facilities so as to separate switching from circuit adaptation, the switch having means for disassembly and reassembly of ATM narrow band channel payloads by providing a mapping between channel addresses and virtual circuit payloads.

2. A narrow band ATM switch as claimed in claim 1, and including means for allocating any channel on the backplane to any time slot in a plurality of virtual circuits whereby to provide a multicast facility.

3. A narrow band ATM switch as claimed in claim 2, and including means for repeating a channel address in the virtual circuit map whereby to provide multicast of that channel.

4. A narrow band ATM switch as claimed in claim 1, 2 or 3, and including a number of ports each of which is coupled to a respective adaptive virtual junctor, and wherein each said adaptive virtual junctor has a junctor virtual circuit with each of the other said adaptive virtual junctors.

5. A narrow band ATM switch as claimed in claim 4, wherein each said junctor virtual circuit comprises an n x 64 kilobit/second connection where n has an integral value.

6. A narrow band ATM switch as claimed in claim 5, wherein n has a value between 6 and 2048.

7. A narrow band ATM switch as claimed in claim 4, 5 or 6, and including time slot resequencing means for ordering time slots in the payloads of cells of the junctor permanent virtual channels in the time slot sequence order of the egress backplane.

by one pair frame stores in common with the AVJs with which the VTG communicates. This is more readily understood with regard to figure 2, where back to back working between the egress and ingress backplane would yield one pair of frame stores redundant. Figure 6 illustrates this process by combining the AVJ and VTG functions in one device. Cells arriving in the egress process are offered to the backplane if they represent narrow band channels of local traffic from another AVJ. Narrow band channels of a VTG are written into a local frame store along with local traffic that is to be transmitted to another AVJ, possibly for onward trunking or as local traffic at that AVJ destination. The egress process may also receive cells from another AVJ and directly write their payload contents to the frame store for those narrow band channels that are to form an ingress VTG. The position in the frame store of AVJ to VTG, VTG to AVJ and local to AVJ channels may be freely chosen and form orthogonal sets of channels, with orthogonal access times to the frame store.

12

Patents Act 1977
E .miner's report to the Comptroller under Section 17
(The Search report)

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GB GB 9502552.4

Relevant Technical Fields

(i) UK Cl (Ed.N) H4K: KOT; KTK

(ii) Int Cl (Ed.6) H04L, H04Q

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Search Examiner
AL STRAYTON

Date of completion of Search
4 MAY 1995

Documents considered relevant following a search in respect of Claims :-
ALL

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	EP 0618706 A2 (GPT)	
A	EP 0614342 A2 (NEC)	
A	WO 94/11975 A1 (ATT)	
A	US 5206858 (NAKANO)	

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

8. A narrow band ATM switch substantially as described herein with reference to and as shown in figures 1, 2 and 3 together with figure 4, figure 5 or figure 6 of the accompanying drawings.

9. A communications network incorporating a plurality of switches as claimed in any one of claims 1 to 8

10. A method of switching narrow band channels in an ATM communications network, the method including allocating said channels to time slots in a plurality of broad band virtual circuits by providing a mapping between channel addresses and virtual circuit payloads.

11. A method as claimed in claim 10, wherein for a channel address is repeated in the virtual circuit map whereby to provide multicast of that channel.

12. A method of switching narrow band channels in an ATM communications network substantially as described herein with reference to and as shown in figures 1, 2 and 3 together with figure 4, figure 5 or figure 6 of the accompanying drawings.